THE UNIVERSITY
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AUG 23 1961

# Gas Journal

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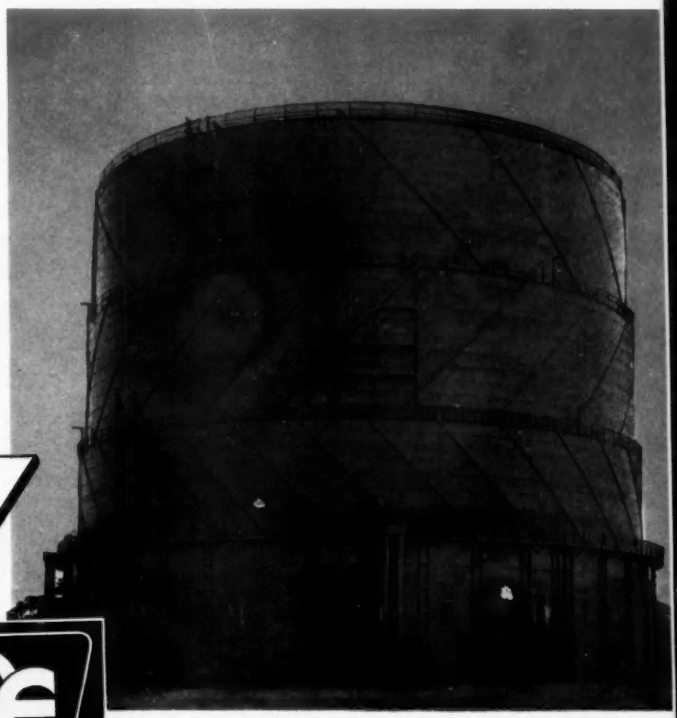

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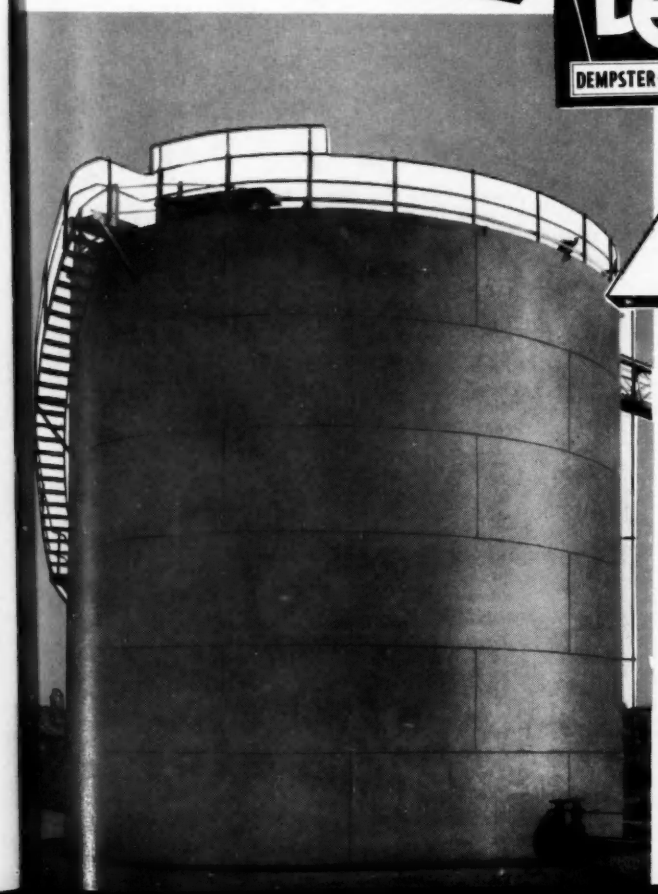

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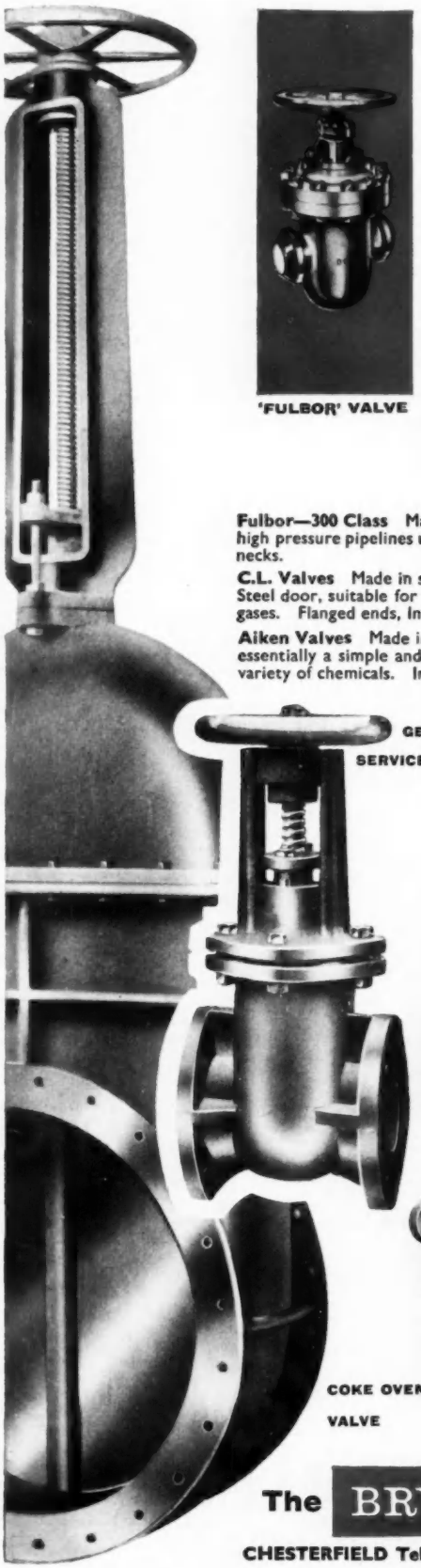



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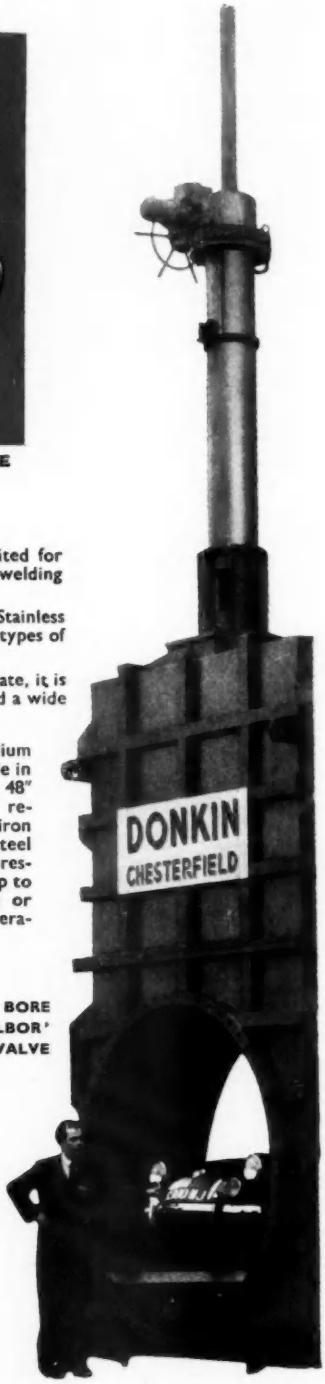


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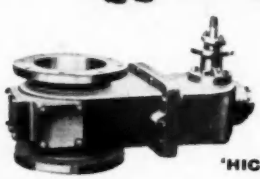

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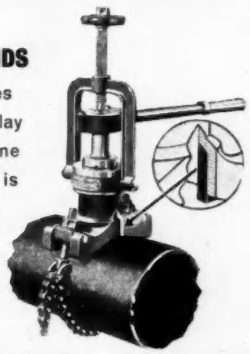

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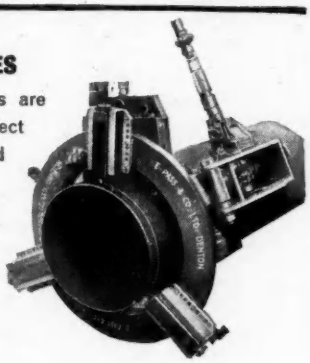

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# Gas Journal

VOLUME 307 • NUMBER 5109 • 113th YEAR

WEDNESDAY, AUGUST 2, 1961


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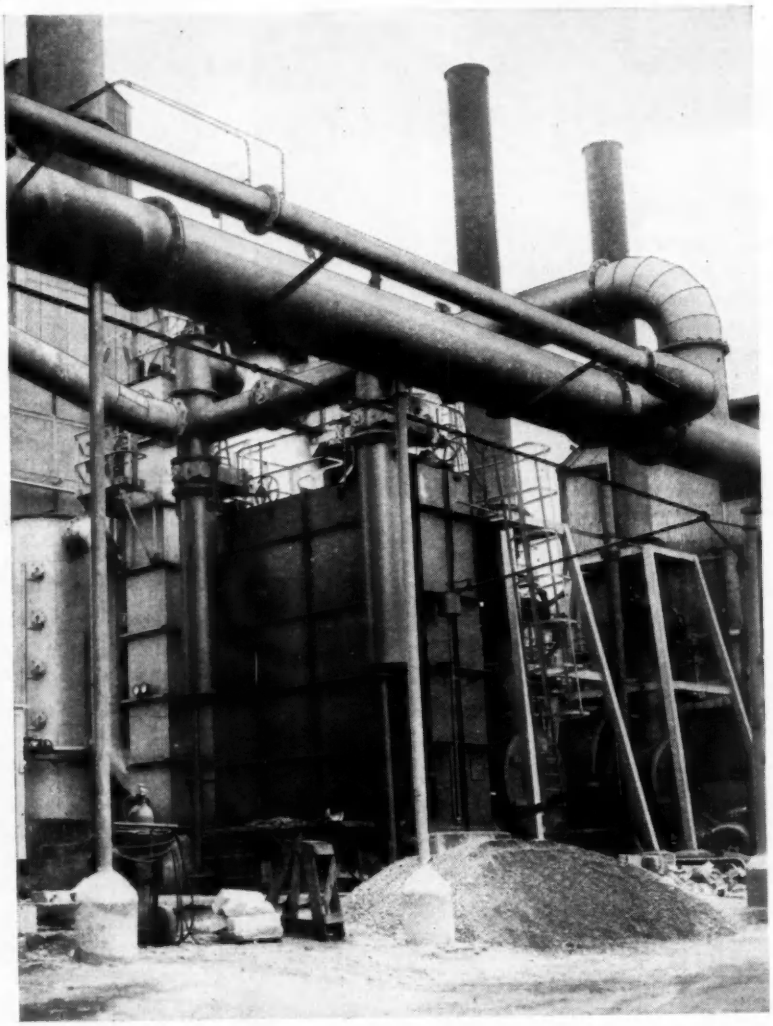
*"Well and truly laid"*



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# Gas Journal

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## *Gas and the 'July Budget'*

THERE can have been few occasions, other than the Budget proper, on which the Chancellor of the Exchequer has created a greater commotion than was achieved by Mr. Selwyn Lloyd last week. Nobody seriously questions the need for imposing economic restraints. This is the third successive year in which Britain's balance of payments has been in deficit, and in addition the country is, to use the Chancellor's words, 'faced with a critical external situation.' Wage increases have outstripped productivity increases, while our spending abroad has exceeded our earnings abroad. Clearly Britain has been living beyond its means and something must be done about it before it is too late. It is the choice of restraint which has angered so many people in all walks of life and industry, and the fact that Mr. Lloyd's remedial measures, closely resembling as they do other measures produced in similar circumstances in the past, include nothing specific which promises any real increase in our productivity or our exports. And there is confusion about whether he is dealing with an immediate crisis or whether he is considering the long-term needs of the economy.

However, one thing seems fairly clear. Insofar as the Chancellor aimed at producing a significant depressive, he will almost certainly be successful. But is this enough? As one newspaper has put it: 'At best it can be said that he is coping with the latest emergency by means of a slightly improved technique of bloodletting.'

It is of course tempting to enlarge on all the monetary and credit measures contained in the Chancellor's statement, but the nature and duty of this journal is such that we must examine this 'July Budget' for factors directly or indirectly affecting the gas industry. Of these, three impress us as being of vital importance.

First, one looks for indications of the Chancellor's policy relating to the broad economics of nationalised industries. Here his words were on the whole reassuring: 'We must see that priority is given to what directly affects national efficiency, and that we do not wastefully disrupt programmes under way. We shall therefore not interfere with the investment that nationalised industries require for attaining their financial targets and providing essential supplies and services.'

On the other hand the Exchequer Advances (Limit) (No. 2) Order which was laid before Parliament on July 25 reduces the increased limit of the nationalised industries' borrowings from the Exchequer contained in the Order laid before Parliament ten days previously. If the Order is approved borrowings during the coming year will be limited to £2,450 mill. instead of £2,500 mill.; this is an increase from £2,050 mill.

The second key effect of the restraints is the result of the purchase tax increase of 10% of the existing rate. Here opinion seems divided, one authority suggesting that consumer demand will be severely curtailed, while another maintaining that, although there will be an adverse short-term effect on sales, it is unlikely to affect the total volume of sales to any considerable extent. Nevertheless, although minimum hire purchase deposits and repayment periods have not been altered, the 2% rise in Bank Rate to 7% must make hire purchase dearer for buyers of durable goods. Happily for gas boards, high value articles like cars will be more affected than domestic appliances.

The third effect is of course the wages 'pause,' and this looks like being the stickiest. It is difficult to imagine that industrial relations during the coming months will be other than bitter. In both direct and Government employment, and in the nationalised industries, the Government seems determined to give Mr. Lloyd's policy priority over other principles of industrial relations. In the nationalised industries the Government will vary its methods according to an industry's financial circumstances; in a healthy industry such as the gas industry it will have to exert indirect pressure to achieve its aims.

*The 'Gas Journal' concludes its review of the technical sessions at the 8th Conference of the International Gas Union, held recently in Stockholm, Sweden.*

**IGU SWEDEN—**
**'Gas Journal' Abstract**

**SECTION 7**

# Review of Technical Sessions

**IGU/47-61 The Problem of Underground Gas Storage in the U.S.S.R.**
*Paper by N. S. Erofeev, U.S.S.R.*

**IGU/20-61 Liquefied Gas Storage in Caverns.**
*Paper by G. W. Benz, Manager, Engineering Dept. Phillips Petroleum Company, Oklahoma, U.S.A.*

**IGU/28-61 Liquid Natural Gases for Town Gas Supply.**
*Review by J. Burns and L. J. Clark, North Thames Gas Board.*

## *UNDERGROUND STORAGE*

MR. DELSOL, of France, presided over this section and made a long introductory speech from the platform. Mr. Erofeev introduced his paper in Russian and took the precaution of listening to the translation of every sentence before proceeding. This had the merit of ensuring that every point was heard and understood by all those listening to the simultaneous translations.

This paper gives a brief analysis of the factors determining the efficiency of underground gas storage in a country where over 75% of the gas produced is consumed by large centres situated far from the natural gas and oil fields. Notwithstanding the remarkable achievements in long distance gas distribution since the implementation of the Seven Year Plan in 1959, there is still urgent need for obtaining theoretical knowledge and practical experience of the technique of underground storage, particularly with regard to improvements in methods of exploration of territory containing depleted oil or gas fields, or porous aquifers.

A method of determining the necessary capacity and optimum productivity of gas storages is described. An important consideration is the gas consumption irregularity factor, which is defined as the ratio of gas consumption for a given month to average annual consumption for a month. Two formulæ are given for calculating the storage capacity needed to meet seasonal variations in gas consumption. Both formulæ give substantially the same factor.

For the cases considered, this ranged from .7 in mid-summer to 1.35 in mid-winter.

$$V = \frac{\Sigma K_{>1} - n_{>1} \cdot 100}{12} \quad \ldots\ldots\ldots\ldots \quad (1)$$

$$\text{or } V = \frac{n_{<1} - \Sigma K_{<1} \cdot 100}{12} \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where V = storage capacity as a percentage of annual gas consumption.

$K_{>1}$ are irregularity factors exceeding 1.

$n_{>1}$ is the number of factors exceeding 1.

$K_{<1}$ and $n_{<1}$ are the same indices less than 1 respectively.

Calculations from the above show that it is reasonable to assume that the storage capacity should be 10-11% of annual consumption, while 'storage deliverability' will be 35-40% of average daily consumption for a year.

Intensive experimental work has been concentrated on storage in aquifiers. Special testing methods are needed in this connection. After the creation of a system of wells uncovering the stratum being explored, and the overlying permeable stratum, tests are carried out on water withdrawal from some wells, and pressure observations on others. On the basis of such tests, aquifier conditions, degree of communication between different sections, absence of overburden leakage, permeability and pressure-bearing characteristics can be determined. The author discusses the technique employed, and gives results of experimental gas and air injections in various fields.

### DISCUSSION

M. FORT (France) pointed out that specific storage capacity was an economic, not a technical point, so the best possible position within a country of suitable geologic formation was very helpful.

DR. JUST (Western Germany) said that the paper was of the greatest interest, and called attention to the value of the Russian experiments in underground storage. Ten years ago, however, gas had been stored in the Ruhr in aquifiers in horizontal layers. Much work still remained to be done, and gas storage in aquifiers would become increasingly important.

Russia was carrying out valuable scientific experiments and would be able to determine the limiting factors, and means of reducing injection and withdrawal times should become possible.

The method of hydro-exploration described in the paper was being used in Germany, too. It was expensive but the information it gave was very useful. He stressed that the problems posed by changes in gas composition on storage must be solved. High-oxygen gases were inadmissible for

storage underground. The carbon monoxide content of such gases must be kept to a minimum since it was formed in the reservoir. By means of metallic nodules, impurities in the gas can be quickly estimated and the carbonyl content measured.

M. RICHARD (France) commented on the few underground storages in France, where they should be developed as in Russia.

DR. A. E. HAFFNER (Great Britain) said he had personally no direct experience of aquifiers, but he greatly appreciated the information made available. There were two small sites being investigated in the South of England, but one of them which had seemed satisfactory had been found to have a fault which ruled it out. There was a 500-mill. field north of Southampton. The next step, however, was legislation.

Town gas was becoming more and more involved in space heating, thus increasing the winter load, the ratio of which to the summer load was therefore also increasing. The cost of underground storage seemed likely to be less than that of peak-load gas. Horizontal storage was particularly interesting.

MR. BURLINGHAM (U.S.A.) described two formations near Chicago. The first, the Galesville, had a capacity of 35 mill. cu.ft., from which the gas was withdrawn relatively dry, while the second, the Mount Simon, produced saturated gas. Gas from the latter could, however, be used to recharge the Galesville.

## STORAGE IN CAVERNS

In his introduction to this practical and well-illustrated paper, Mr. G. R. Benz, manager of the engineering department of Phillips Petroleum Company of Bartlesville, Oklahoma, states that the development and growth of the liquefied petroleum gas industry has been spectacular. From a very small beginning in the 1920's, the industry grew steadily until about 1940, and since that time has experienced a very rapid growth. Sales of l.p.g. in the United States increased from approximately 300 mill. gal. in 1940 to about 9,000 mill. gal. in 1959.

The high cost of storage in steel tanks placed above ground plagued the industry for many years. As the use of l.p.g. grew, especially for house heating, the amount of storage required increased tremendously. It became evident that if the l.p.g. industry were to hold its own in the competitive field of energy fuels, lower-cost storage had to be developed.

Underground storage in caverns has gained wide acceptance in the U.S. since its first use in 1949. Approximately 92% of the 2,500 mill. gal. of underground storage capacity in operation, or under construction, at the end of 1960 was dissolved from salt formations and the balance of 8% was of the mined type in rock or shale formations.

These underground caverns have been constructed by solution mining methods in both salt domes and in salt layers, as well as by conventional hard-rock mining methods in shale, chalk, limestone, granite and other suitable formations. Prior to the use of underground storage for l.p.g., the usual method employed was a battery of steel pressure tanks located above ground and having a design pressure of 250 p.s.i.g. and a factor of safety of 4.

The cost of underground storage for l.p.g. is less than the cost of steel storage tanks located above ground in volumes exceeding 400,000 to 1.2 mill. gal., with the exact cost for any particular storage system dependent upon such factors as vapour pressure of the gas to be stored, depth of suitable formation in which a cavern can be washed or mined, geological location of the facilities, rates of input and output needed, the amount and type of storage facilities required, time available for construction, the amount and type of surface facilities required, and availability and cost of water and a satisfactory way to dispose of the brine in the case of caverns dissolved from salt formations. It is important to make a thorough study of the underground formation before selecting a site and designing the facilities.

The operation of underground storage systems has been satisfactory and has presented no unusual problems. Recovery of stored l.p.g. from underground storage systems has been virtually complete, many caverns having been filled and emptied numerous times. The gas is removed from the caverns by deep-well type pumps, in the case of mined storage, and by salt water displacement in the case of caverns mined by solution mining methods.

The increasing use of l.p.g. for the heating of homes and factories has caused a heavy demand during the winter months. This peak winter demand can only be coped with by storing the off-peak or summer excess. Low cost storage is a necessity.

### DISCUSSION

M. DHUIN (France) said that the underground storage of l.p.g. was no longer a monopoly of the U.S.A., and referred to storages now completed at Antwerp. He said that a cavern was being washed out near Lacq, which would have a capacity of 200,000 tons. He went on to discuss the fluctuation in costs of building these caverns and said that changes in costs determined the nature and form of the storage adopted. The American techniques for preparing a cavern were most ingenious and the economics behind all this work was most interesting.

M. BERTHIER (France) dealt with the drilling of wells, and as a member of an oil company was more accustomed to those of small diameter rather than those of large capacity mentioned by other speakers.

## LIQUID NATURAL GAS

Dr. J. Burns and Mr. L. J. Clark, respectively Deputy Chairman and Assistant Chief Engineer of the North Thames Gas Board, review the trends and changes in technical and economic factors influencing the selection of certain raw materials for gas production and relate these to the competitive situation of town gas in comparison with other forms of refined fuel.

The overall situation regarding natural gas supplies is reviewed and note is taken of the importance of this form of energy in countries where it is indigenous. This also provides an indication of the potential use of natural gas in other countries by techniques of liquefaction and sea transport. This method of transporting natural gas has been proved by the successful trials of the Methane Pioneer. Consideration is given to the factors affecting the cost of this form of transportation and particularly the price of gas at source and the distance of haul. These factors are also related to the economics of gas transmission by pipeline. In general, it is found that for the shorter distances up to 1,000 to 1,200 miles, the advantage lies with pipelines, but for longer distances ship transport becomes more economical.

The various factors affecting the design of storage terminals are reviewed, together with the possible utilisation of the 'cold' in the liquid methane, and the advantages of compression in the liquid phase prior to regasification for long-distance gas transmission.

The methods used for introducing and marketing natural gas in countries such as the U.S.A. and U.S.S.R. are considered and related to the possible applications for imported methane in the U.K. In the initial stages much of the methane will probably be reformed and used to supple-

ment normal town gas. There will, however, be many applications where it can be supplied directly to large consumers or used to enrich either town gas or low grade gas produced from coal. Such applications are related to a possible national production plan and grid supply, based on coal, oil and imported natural gas.

In the last decade great progress has been made in developing systems for the large-scale storage of natural gases either in underground porous structures, or in caverns, and more recently some encouraging progress has been made towards developing a system for the underground storage of liquid methane at sub-zero temperatures.

Liquid petroleum gases are likely to have an important, though eventually limited, use in the British gas industry. At the present time these materials possess some economic advantage over alternative feedstocks for gas production.

## DISCUSSION

MR. KELLY (Great Britain) with the aid of slides, dealt with the cost of storing liquid propane, and showed that refrigeration was cheaper than using a cavern, provided it was on a comparatively small scale. Referring to the cost of tanks, he said that an aluminium-magnesium alloy tank cost half that of stainless steel, while a 9%-12% nickel alloy tank was about 10% cheaper. Prestressed concrete tanks with a metal lining were undergoing trials and if successful they should be far less expensive, some 60% of the aluminium alloy tank.

If the gas was stored for long periods and only withdrawn, say to meet the peak winter load, the metal-lined concrete tank could provide even cheaper storage. In view of this possibility he asked whether the author would be willing to revise his prices, if the gas was to be withdrawn only once a year from a concrete tank.

M. R. DELSOL, the chairman, described plans being made in France to store liquid methane and also for its transport.

MR. L. J. CLARK, replying to the discussion described the review as the record of an infant industry. It would change and change again, so a flexible outlook was needed; a good deal of work was being done in the U.S.A., France and, of course, the U.S.S.R., on the best possible ways of using methane.

Sea transportation of methane was technically possible and the economics of the operation were attractive for Great Britain. It was of great value to the gas industry since it provided a means of diversifying raw materials. There were certain problems posed by introducing a shipping operation, as there were by laying a pipeline, which must be large to be economic. Underground storage of the liquefied gas was helpful and could make a great difference especially when used in conjunction with the shipping operation.

The different materials for the tanks, referred to by Mr. Kelly, were an important consideration, especially the reinforced concrete structure with the metal lining, if practical. Cost at 5d. a therm for storage for 'once in and once out' was reasonable, especially for peak load gas. A large scale operation involving 100 mill. cu.ft. per day was about to be made. It would, he hoped, become an established commercial operation.

There then followed an excellent colour film of the experiments being carried out by the French gas industry in laying a pipeline some 9,000 ft. deep in the Mediterranean between Mostaganem on the Algerian coast and Carthagena in Spain. The commentary was read in French by a member of the French contingent to the conference.

## IGU SWEDEN—'Gas Journal' Abstract

## SECTION 8

**IGU/7-61** **Processing Methods for Particular Gases According to Their Nature and Utilisation Characteristics.**
*Paper submitted by the Association Technique de l'Industrie du Gaz en France.*

**IGU/42-61** **The Production of Town Gas with Reduced Carbon Monoxide Content.**
*Paper by F. Jordi, Director of the Gas- and Waterworks, Basel, Switzerland.*

**IGU/41-61** **A New Centrifugal Gas Washer—New Possibilities for the Treatment of Coke Oven Gas.**
*Paper by Sven Dahlbeck, Technical Manager of the Stockholm gasworks.*

**IGU/31-61** **Repairing and Reinforcing the Concrete Tank of an 80,000-cu.m. Gasholder.**
*Paper by G. Vitali, of Società Edison, Italy.*

## PROCESSING METHODS FOR PARTICULAR GASES

THIS paper was contributed by the French Association Technique. It lists the various methods used to eliminate the impurities contained in particular gases, mainly those manufactured by cracking or reforming hydrocarbons, natural gases and coal gas used under pressure.

The first section enumerates the impurities considered and their importance, according to manufacturing method and raw materials employed, regarding particularly catalytic cracking of petroleum oils, the Hall process, natural gas at Lacq, refinery end products, Gaz Integral, Lurgi gas and coal gas.

Next are described the distinctive processing methods used (a) for manufactured gases, (b) for natural gas (elimination of hydrogen sulphide, chiefly concerning Lacq works), and (c) for coal gas intended for underground storage at Beynes.

The conclusions indicate that, although the processing of certain gases is based on special techniques that have been re-adapted, they can be regarded as providing useful guidance; a direct and very full study is nevertheless essential in order to find out how best to apply the processing methods referred to in each individual case.

Appended is an analytical summary of replies to an inquiry, asking the type of manufacture and the processing methods employed in each plant, which was addressed to 11 Member Countries.

## LOW CARBON MONOXIDE CONTENT

The influence of the carbon monoxide content of town gas on the incidence of accidents is well known and the need to reduce it is now accepted. There are a number of methods for producing a gas of reduced toxicity, and these include the use of natural gas, natural gas/air mixtures, l.p.g. and l.p.g/air mixtures.

Gases of reduced CO content may also be produced by cracking natural gas, petroleum or petroleum derivatives with small amounts of steam and air, as well as increasing the calorific value of town gas from carbonisation by reducing the quantity of producer gas or water gas added. When neither of these gases is added, town gas has a CO content of about 6-7%, the calorific value and CO-content being reduced by adding flue gas.

Other means of affecting the reduction of the CO content of mixed gas are by catalytic conversion of the CO with steam into hydrogen and carbon dioxide, by methanisation, whereby the CO is converted catalytically into methane and steam with the hydrogen in the mixed gas, by the Fischer-Tropsch reaction, by washing with a suitable solvent and recovering practically pure CO from the solvent, and finally by the CO conversion with gas components of low CO content.

Other points discussed in this paper are the conversion of CO with steam at the Basel gasworks, the yield of the Basel conversion plant, the effects of CO conversion, and the costs of conversion.

## GAS CENTRIFUGE FOR WET PURIFICATION

Over the past few years a gas centrifuge, capable of selective scrubbing has been developed at the Stockholm gasworks. It works on the principle of the gas being forced counter current to the washing liquid distributed by a spray over a number of vertical plates inserted in the rotor of a centrifuge. It will be clear that the time of contact between the gas and the liquid will be short.

The first operational model, used as a benzole scrubber, gave such good results that two further centrifuges were installed to remove $H_2S$ by washing the gas with ammonia liquor, and for the cooling of gas leaving the exhausters.

The design has been improved and later installations undertake detarring, naphthalene removal, benzole washing, as well as being used as a heat exchanger to increase the efficiency of a gas producer.

Their small size makes it possible to install them in existing buildings with the minimum of alteration; they are also very reliable.

The paper describes the results and operational experience gained from the use of these centrifuges at Stockholm in some detail.

## REPAIRS TO GASHOLDER TANK

With a capacity of 80,000 cu.m.—about 2.8 mill. cu.ft., this holder was erected at Milan in 1906, and its tank built of non-reinforced concrete. Faults in the structure of the tank causing loss of water and the need for repairs to the steel work, were responsible for the decision to take the holder out of service and thoroughly overhaul it.

After draining and cleaning the tank, a serious crack running horizontally through the entire thickness of the tank, at about 3/5 of its height, and 15 vertical cracks were found; five of these latter ran through the entire height of the wall down to the foundation plinth.

Repairs were carried out by running cables round the periphery of the tank, which when made taut set up an inward thrust equivalent to the hydraulic thrust in ⅔ of the wall. Vertical cables were also used to anchor the columns and so restore the vertical stability of the tank. Thus the structure became sufficiently rigid to withstand the stress transmitted by the guiding columns and ensure that the plaster lining remained completely watertight. The paper describes these operations in some details and illustrates the positioning of the reinforcement cables by diagrams.

# IGU SWEDEN
## 'Gas Journal' Abstract

# SECTION 9

**IGU/44-61 Progress in Gas Distribution in the U.S.S.R.**
*Paper by F. A. Trebin and A. T. Sorokin, U.S.S.R.*

**IGU/39-61 The Utilisation of the Jet Compressor for Natural Gas Transmission in Rumania.**
*Paper by A. Pascaru and P. Svoronos, Rumania.*

**IGU/25-61 Natural Gas in France and its Treatment.**
*Paper by L. Barbouteau, Head of the Development Dept., and R. Guillo, Head of the Construction Dept. of Société Nationale des Pétroles d'Aquitaine, France.*

**IGU/40-61 A New Process for Removing Gasoline from Natural Gas Dissolved and Associated with Petroleum.**
*Paper by I. A. Niculescu and N. Petcu, Rumania.*

## DISTRIBUTION PROGRESS IN U.S.S.R.

MR. POTTER (U.S.A.) was the chairman of the section. He briefly outlined the subjects to be discussed and called upon the authors to present their paper.

Mr. F. A. Trebin and Mr. A. J. Sorokin remind us that the first trunk gas main, from Saratov to Moscow, was put into service in 1948, at which time exploratory drilling for natural gas was carried out only on a very small scale and gas consumption was limited to public utility services.

It was after 1956 that the gas industry began to develop

rapidly, which is clear from the following data on actual and projected gas output and production, in mill. cu.m.: 1955, 10,400; 1959, 37,200; 1960, 47,100; 1965, 150,000.

Construction of gas mains, which is highly mechanised, has been carried out on a large scale; their total length increased 3.3 times in 1959 as compared with 1955, and the pipelines are mainly of large diameter (720 to 1,020 mm.).

By the end of 1959, gas was being supplied to more than 230 towns and 166 workmen's settlements. By the end of 1965, towns and workmen's settlements with a total population of more than 40 mill. will be supplied with gas.

Realisation of such high rates of development of the gas industry is based on the availability of large reserves of natural gases in various regions and in almost all of the suitable geological formations of the U.S.S.R. The total estimated gas reserves in the U.S.S.R. are 55 to 60 trill. cu.m.

The utilisation of liquefied petroleum gases is also being widely developed. They are used as a raw material in the chemical industry, as a source of town gas and for distribution to settlements situated far from gas mains, as a motor transport fuel, and for agricultural machinery and other purposes. Distribution is by pipelines as well as by specially designed mobile tanks and in cylinders of various designs and dimensions.

### DISCUSSION

MR. D. TIMBERGEN (Netherlands) commented on the tremendous speed with which developments had taken place in the Soviet Union, and asked whether (a) old houses were converted to use gas at the expense of the state, (b) the large proportion of gas consumed by industry evened out the demand, (c) the larger cities were supplied by more than one feeder, (d) air pollution was still a problem in those towns using solid or pulverised fuel.

DR. SIEBEL (Western Germany) asked whether gas in Russia was used for both cooking and space heating, and if so, in individual units. He was interested to know how the gas industry in Russia operated, and pointed out that in Germany there was severe competition from electricity.

MR. ALI-ZADA (U.S.S.R.) spoke of the spread of gas consumption throughout the republics in the Caucasus by the building of local networks. He had been interested in the paper on the detection of gas leaks by dogs, and he said that if it were possible the dogs should be trained to find leaks in asphalt covered streets. He referred to the French film on the laying of the pipeline under the Mediterranean, and stressed the value of this in its relation to the fuel needs in Europe.

M. R. DELSOL (France) asked whether any experiments had been made in the transport of liquid propane in Russia.

Replying, MR. SOROKIN thanked the meeting for showing so much appreciation of his paper. Answering Mr. Timbergen, he said that old houses were converted to use gas at the expense of the state, and in large cities and workmen's settlements the consumption of gas had increased enormously. It now amounted to 150,000 mill. cu.m., having grown from 22,000 mill. cu.m. in 1955.

As the gas industry expanded, so was the domestic consumption expanded, and any levelling off of consumption was done by adjusting the industrial consumption. Some industries might use gas for nine months in the year, some for only six months, and yet again some only when gas happened to be available. The latter would work principally on liquid fuels.

The large cities were supplied by several feeders, and in Moscow there were three feeders supplying a ring main.

On the subject of air pollution, he said that where it had been caused by the internal combustion engine, it had been obviated by converting automobiles and transport vehicles to burn propane.

Other questions he would reply to in writing.

## JET COMPRESSORS IN RUMANIA

The supply of methane from natural gas wells to the more distant consumers requires high initial pressures and entails high capital cost, so the rational exploitation of methane reserves should take this into account by supplying distant consumers under natural pressure for as long as possible.

The methane supplied to local consumers, therefore, should be taken from geological formations working at lower pressures than that of the pipeline supplying distant consumers, and the natural energy of high-pressure wells should be used for compressing gas from wells where natural pressure is lower than that of the pipelines supplying the more distant consumers. In this way the installation of mechanical compressors with their high capital and operating costs, may be deferred.

High-pressure natural gas applied to a jet compressor is a convenient means of increasing the overall pressure at the wells, so that the flow through the pipeline is maintained at an appropriate average pressure, increasing the pressure of gas from partially exhausted wells. The compression ratio may be as high as 2, or even greater. Satisfactory operation up to a ratio of 1.2 may entail, it is estimated, power savings for a gas rate of 1 mill. cu.m. per day.

The main advantage of the jet compressor is that it may be easily designed and constructed in very small units for use wherever there are both high-pressure wells and gas pressures lower than those in a pipeline.

Capital and operating costs are much lower than for mechanical compressor installations, which can only be planned as central stations and require access roads, water and power sources, communication lines, buildings and other expensive facilities.

In Rumania, from 1955 some 2,000 mill. cu.m. of low-pressure gas have been compressed in this way, representing 15% of the gas supplied to distant consumers.

### DISCUSSION

MR. R. HUTCHINSON (Great Britain) said that in Great Britain, jet compressor ratios up to 3:1 had been obtained, but the lower figures quoted in the paper were of interest since they combined with greater efficiency. He asked what were the gas velocities envisaged in the paper and whether the diameter of the orifice was of little influence in the attainment of the increased pressure.

Replying, MR. PASCARU said he would answer fully in writing, but said in passing that the intake of the mixing chamber took a sudden change of direction and caused turbulence in the flow through the appliance.

## TREATMENT OF NATURAL GAS IN FRANCE

M. L. Barbouteau and M. R. Guillo, respectively Chiefs of the development and manufacturing departments of the Sté. Nat. des Pétroles d'Aquitaine, presented this paper. Their natural gas is mostly processed near Pau.

The composition of this gas, and its $H_2S$ content in particular, call for two desulphurisation stages; the first

involving scrubbing with water, and the second being a final desulphurisation with amine.

Desulphurisation with high-pressure water requires special equipment and has called for research into the balancing of water and unprocessed gas and into pure technology. Much study was especially devoted to safety precautions.

Actual operation has shown that scrubbing with water removes virtually 50% of the acid gas in the unprocessed gas. However, since the temperature of the circulating water is one of the main factors in this absorption, it is preferable to adapt a system of removing the heat of absorption. The solution is cooled in the turbines, which recover the work arising from the two successive reliefs sustained by the acid gas-enriched solution. These two reliefs are necessary to permit regeneration of the scrubbing water without any heat contribution.

Other factors affect the economics of this process—in particular, the need to re-scrub the gases resulting from the first relief operation.

Observed corrosion in such an installation without an inhibitor can reach 1 mm., but laboratory work has shown that this corrosion can be markedly reduced by the use of an inhibiting agent.

The thermodynamics balance of a system involving scrubbing with water and desulphurisation with amine is distinctly superior to that resulting from a single scrubbing with amine.

There was very little discussion on this paper, the most interesting of which was a reference to the cleaning of natural gas from Lacq by M. BRAMSLEER of France.

## REMOVING PETROL FROM NATURAL GAS

As a result of research into new processes for hydrocarbon separation by adsorption on activated carbon, working at temperatures above 60°C, methane can be removed from the gas as well as a high proportion of $C_2$ hydrocarbons. For adsorption at these temperatures it is no longer necessary to dry or cool the adsorber before use.

The adsorbed hydrocarbons are recovered by superheated steam, and adsorption resumed immediately.

The new process has simplified plant lay-out and reduced production costs substantially, especially since the adsorber need no longer be cooled or dried out.

## IGU SWEDEN—
## 'Gas Journal' Abstract

## SECTION 10

**IGU/23-61 Steam in Gas Production.**
*Paper submitted by Association Technique de l'industrie du Gaz en France.*

**IGU/14-61 Cause and Effect of Raising the Calorific Value of the Vienna Town Gas from 4,250 to 4,600 k cal. per cu.m.**
*Paper by W. Jorde, Vice-director of the Vienna City gasworks.*

**IGU/32-61 The General Adoption of the Units of Système International d'Unités in the Gas Industry.**
*Paper by D. Tinbergen, Netherlands.*

## STEAM RAISING AND GAS PRODUCTION

STEAM raising in the gas industry has been undergoing a change because of the growing demand for steam as a raw material, and the tendency to abandon the traditional coke or breeze-fired boilers in favour of waste heat boilers, fitted with superheaters.

Those undertakings, this report points out, which still have solid fuel-fired boilers may still be using them but are not replacing them. In some cases they may be converting them to oil firing. Most of the newer installations include quick firing oil-fired boilers which serve to balance the waste heat boilers and so add a certain flexibility to the works steam raising system.

Dealing with water treatment, the report points out that the processes used vary with the importance of the steam raising plant and the quality of the water to be treated. However, the old established means of treatment by lime and 'Calco-soda', and the sodium carbonate treatments with continuous drainage are common, though processes based on ion exchange are being increasingly used.

Local installations tend to recover low pressure steam from prime movers since it is uneconomic to transport it any distance, though in cyclic reforming plants it is often preferable to expand high pressure steam without work to maintain its temperature. The production of electricity, the report says, is no longer practised in new installations.

It would clearly be uneconomic to abandon old steam raising installations too soon, so a means of adapting them efficiently to modern conditions should be sought, remembering that the overall efficiency of gas production must not be sacrificed by inefficient steam raising plant.

## THE C.V. RAISED IN VIENNA

Rapid increases in gas consumption in the city of Vienna from 1953, reaching a maximum rate in the cold winter of 1956, have been met by the increasing availability of practically sulphur free natural gas.

Between 1952 and 1956 ten natural gas/air plants were installed, which enabled the quantity of producer gas used as a diluent to be progressively reduced. Catalytic reforming plants enabled the hydrogen content of the gas to be increased, and four such plants are now in operation. By such measures as these, the demands for gas have been met and the quantity available to meet possible future expansion has increased.

From 1956 onwards, however, the increase in demand, though met by the gas production plants, was greater than the carrying capacity of the mains. After carrying out

rigid tests on the effect of an increased calorific value on selected appliances and after independent checks by the Fuel Department of the Technical University of Vienna, it was decided to raise the c.v. of the gas distributed in the city from 4,250 k cal. per N cu.m.—446.2 B.t.u. per cu.ft. —to 4,600 k cal. per N cu.m.—483 B.t.u. per cu.ft. In this way the carrying capacity of the mains has been raised by 10%.

The effect of these changes has been to reduce the number of service complaints—and they continue to decrease—which confirms that the number of appliances in good working order has increased and all are suitable for the gas of higher c.v.

## INTERNATIONAL UNITS FOR GAS

The adoption of the Système International d'Unités (S.I.) was proposed for universal acceptance by the Comité International des Poids et Mesures in 1956, having basic units of length, mass, time, electric current, thermodynamic temperature and intensity of light. The units have been defined, and dependent units calculated from them. It had to be realised that the choosing, fixing, and defining of units was not a static, but a continuous task, following scientific and technical development.

The purpose of the present report was to indicate the main advantages of the S.I., and was not primarily concerned with problems of defining new units or altering definitions of existing ones. Its starting point was the opinion of leading experts, and its aim was to try to find how they could best proceed in order to introduce the system, first into general science, and technology, and particularly into the gas industry, as soon as possible.

In order to apply any method of introducing such a system, it was necessary to separate the inborn human resistance to change of any kind, from local or specific types of opposition, arising from particular circumstances. In presenting an argument for the desirability of adopting the changes, it was a mistake to minimise the emotional resistance which often shelters behind reasonable motives based on difficulties or costs of adoption.

In this connection, an analysis of the real difficulties, while probably not affecting the emotional resistance of the person himself, would generally restrain him from passing on the latter to other people. Undue advocacy of haste, however, might increase opposition, since it was much easier to take a decision which would not come into effect at once than one which had to be implemented immediately.

While it was obviously impracticable to attain simultaneous universal adoption of such a system, if only on the ground of lengthy consultation, things could certainly be speeded up within a compact single body such as the gas industry, which might well make the changes on its own initiative.

### DISCUSSION

MR. BLANDON (Great Britain) said that it was always assumed that only sentiment and conservatism supported the Anglo-Saxon units, and that the metric system was a wholly rational one. As an English scientist, familiar with both systems, and critical of both, he found both these assumptions to be untrue.

That everyone counted decimally, because he was born with ten fingers, was well known, but any mathematician knew that 12 of them would have been a better arrangement. But counting was only one aspect of the manipulation of a system of units. Numbers could easily become an obsession in themselves, and the number 100 was no exception. There was no practical advantage whatever in having 100 degrees of temperature between the freezing point and the boiling point of water; this was the purely doctrinaire approach. Mr. Fahrenheit—not, by the way, an Anglo-Saxon—had adopted a far more practical approach in setting his zero at the lowest temperature he could produce. As a result meteorological work on the Fahrenheit scale very seldom had to use a negative reading.

The use of binary fractions for engineering purposes was very flexible and convenient; it was rather like a four-speed gear box whereas decimal fractions were, by comparison, only one-speed. For all sorts of practical purposes division by factors of two and three were important. One part of the decimal system that had had to be abandoned was the division of a right-angle into 100 instead of 90 degrees—geometricians would not tolerate an equilateral triangle with angles of $66\frac{2}{3}°$ each. In fact the only true international units were those of angular measure and of time, which were sexagesimal, combining the duo-decimal and the decimal principles.

The British monetary system—so often the supreme target of ridicule—was a highly sophisticated combination of decimal, duo-decimal, and binary principles. By the alternative division of the £ into ten major coins or into eight, the principle of the Vernier scale was incorporated, with the practical benefit that the proportion of minor to major coins handled in everyday transactions was smaller than could ever be achieved with decimal coinages.

The fractional coins of a unit in a decimal coinage were normally .5, .25 or .2, and .1. The fractional coins of ten shillings sterling (ironically, it was the decimal stage of the British currency that was involved) are 2.5, 2, and 1. Thus in paying with a ten-shilling note for various small sums, the change received was normally as follows:—

for 5s. . . . . $3 \times 2.5 + 1 \times 2$,

for 1s. . . . . $2 \times 2.5 + 2 \times 2$,

for 1.5s. . . . . $1 \times 2.5 + 3 \times 2$, etc.

This was exactly the principle of a Vernier scale.

In the interests of international standardisation, Britain would probably have to adopt the metric system. But to practical people, it would be, not a step forward, but a sacrifice.

## COUNCIL MEETING

At a meeting of the Council of the International Gas Union held in the Town Hall, Stockholm, on June 27, 1961, presided over by Mr. Bengt M. Nilsson, its President, and assisted by Mr. R. H. Touwaide, its General Secretary, delegates from all member countries, including three Honorary Presidents approved unanimously the application of the Finnish Gas Association for membership.

Mr. J. van Dam van Isselt, General Manager, Gemeentelijk Energie-en Vervoerbedrijf Utrecht and Past President, Vereniging van Gas-fabrikanten in Nederland, was elected President for 1961-64, and Mr. B. M. Nilsson unanimously appointed as Honorary President.

Other appointments for the three years 1961-64 were, as Vice-Presidents, Dr. W. Jorde (Austria), M. F. Rombouts (Belgium), M. Y. Quéret (France), Dr. J. Burns (Great Britain), Dipl. Ing. D. Ing. E.h. W. Wunsch (Federal Republic of Germany), Dipl. Ing. A. Graf (Switzerland) and Prof. Dr. Ing. R. Riedl (Czechoslovakia), and as Honorary Vice-President M. P. Mougin, while Mr. R. H. Touwaide was reappointed General Secretary with Mr. J. H. Steinkamp as the President's Secretary.

The 9th International Gas Conference will be held in Amsterdam in June, 1964.

## Gas industry 'dare not stand still'

*IN facing the fierce competition that exists between different fuels today, the gas industry dare not stand still, says Mr. C. H. Leach, new Chairman of the West Midlands Gas Board.*

*Mr. Leach, who has been Chairman of the Southern Gas Board since 1956, took up his new appointment on August 1.*

*Writing in the August issue of the* West Midlands Gas Board Magazine, *he states:*

*'No one realises better than I that I have a difficult task in following Mr. G. le B. Diamond as Chairman of your Board. At the same time, if the task is one of difficulty it is also one of privilege, for the name of the West Midlands Gas Board stands high throughout our great industry.*

*'In facing the fierce competition that exists between different fuels today the gas industry dare not stand still, or try to rely on an existing reputation, no matter how good. Inevitably, there must be changes if we are to adapt ourourselves to varying circumstances and keep ahead of our rivals.*

*'You have already made many changes in the West Midlands, as was done in the Southern Board. Let us pool our knowledge and, in planning future policy, remember the success—and the mistakes—we have had in the past.'*

# Record sales of gas: 3% up over year

DURING the year, April 1, 1960—March 31, 1961, which corresponds to the industry's financial year, sales of gas (meters read) increased by more than 3%, reaching a total higher than the industry's previous record sales in 1957-58. The increase was spread over all types of consumer, domestic sales being nearly 2% higher, while both industrial and commercial sales increased by more than 4%.

The overall picture on sales of appliances was a varied one. Both refrigerators and space heaters showed an increase of nearly 10%, but there was a drop of more than 25% in cooker sales, and sales of water heaters were slightly lower.

Gas production was at almost the same level as in the previous year, but there was an increase of about one-eighth in purchases of gas, giving an overall increase of more than 2½% in total gas made and purchased.

There was a slight fall of just over 1% in the tonnage of coal carbonised. Coke production, too, was at a somewhat lower level.

New plant brought into use during the year had a total daily capacity of 48.8 mill. cu.ft. and there was a net increase of 1,633 in the mileage of mains. The number employed in the industry fell from 124,680 to 122,599 between May 1960 and May 1961.

## FARMERS SAW GAS AT WORK

THE use of gas in agriculture is increasing every day and, besides aiding the farmer in heating barns, cowsheds, incubators and brooders, and providing him with a nitrogenous fertiliser, years of research have produced domestic equipment for use in his farmhouse.

At this year's Royal Welsh Show at Llandilo, Carmarthen, a working gas central heating installation was one of the main attractions in the Gas Pavilion.

A comprehensive range of domestic appliances for the farmer's wife was displayed.

The Pavilion, presented by the Gas Council in co-operation with the Wales Gas Board, was arranged to include an all-gas kitchen where cookery demonstrations were given.

## *Parkinson Cowan sign sales agreement*

A SALES agreement has been made between the American Meter Co. Inc., Philadelphia, U.S.A., and Parkinson Cowan Gas Meters Ltd.

All the equipment covered by the agreement is for use with the new type of high-pressure meter, recently introduced into this country by Parkinson Cowan, and also with the Connersville-type meters distributed by W. C. Holmes.

**NEWS SUPPLEMENT**

## *TRIBUTES TO MR. DIAMOND*

**AFTER leading the West Midlands Gas Board for the first 12 years of its existence, Mr. G. le B. Diamond retired from his appointment as Chairman on July 31. In the last weeks of his chairmanship, Mr. Diamond received many tributes to his personal abilities and the achievements of the Board, and was presented with a number of handsome gifts.**

**The gift of fellow members of the Board was an antique walnut bureau, with which was an embossed leather writing case with an appropriate inscription and the names of subscribers. It was presented by the senior Board member, Professor F. H. Garner.**

**The largest single gathering to say farewell to Mr. Diamond was held at Wulfrun Hall, Wolverhampton, and attended by more than 200 senior staff from all parts of the area. They had all joined in the presentation of an antique walnut tallboy and two Regency chairs, which was made on their behalf by Mr. J. E. Wakeford, Birmingham Divisional General Manager.**

**The farewell gifts of members of the Senior Staff Conference were a wristlet watch for Mr. Diamond and a cameo brooch for Mrs. Diamond. They were presented by Mr. J. Swan, Secretary of the Board.**

**At his last meeting of the West Midlands Gas Consultative Council, Mr. Diamond was presented with a Georgian silver coffee pot.**

**Mr. Diamond received a record-playing unit for incorporation in one of his own cabinets from the Midland Junior Gas Association; a folding chair from area headquarters graded staff; a Worcester china coffee service from staff in the Worcestershire and Herefordshire Division; and Doulton ware from the graded staff of the North Staffordshire Division.**

**Tributes and gifts came also from outside the gas industry. Leading members of the coal and fuel distributing trades in many parts of the country entertained Mr. Diamond to lunch and presented him with a television set.**

**From North Staffordshire pottery manufacturers came a Minton bowl.**

**Mr. Diamond was entertained by the Gas Council this week and presented with a Venetian scene printed by a modern Italian artist.**

# Methane and Lurgi gas: More pressure on Power Minister for statement

THE Minister of Power, Mr. Richard Wood, has been asked again in the Commons about the importation of liquid methane, both as regards Gas Council proposals and expectations his department has received from the National Coal Board of the result of introducing methane gas produced by coal in order to benefit both industries.

He said it was a complicated matter and a statement was 'most unlikely' before the House rose.

The Minister said no financial authority had been sought by or given to the Gas Council for the installation in Durham coalfield of a Lurgi-type gasification plant.

**'Dishonest . . .'**

Pressed to say whether he was prepared to give serious consideration to the establishment of a Lurgi plant in the North-East if the system proved an economic proposition, Mr. Wood said he would consider further Lurgi plants if the process turned out to be fully competitive, but it would be dishonest of him to raise hopes about Lurgi plants being built in Durham because, as he understood it, the qualities of Durham coal were not thought most likely to be very suitable for the process.

He was further asked if, before giving consent to such proposals as the Lurgi project, he would consider the advisability of (1) importing methane (2) the cracking of suitable petroleum feedstocks imported into the United Kingdom which would produce gas at an economic price.

Mr. Wood said he was considering broadly the methane proposals, the use of petroleum feedstocks and the Lurgi process all as part of one consideration.

Reference was made to the political instability in parts of the Middle East from which proposed imports of methane were to come. An assurance was sought that he would not sanction the import of methane until he knew the results of the studies made by the Gas Council and the National Coal Board as to the success of the Lurgi process.

The Minister said he could not go so far as to say that he would definitely wait for the outcome of the studies, but he would certainly wait until he was himself satisfied about the comparative merits of the different ways of making gas here.

## COAL SCIENCE CONFERENCE

THE next International Conference on Coal Science, the fifth of its kind, will be the first to take place in the United Kingdom—in 1963.

The conference, which meets every two years, is to be held at the Town Hall in Cheltenham, Gloucestershire from May 28 to 30, 1963.

The first three conferences were held in Holland and the fourth in France.

## H. & G. SIGN AGREEMENT

A FURTHER agreement with the German Democratic Republic covering know-how and licences for a wide range of processes in the German chemical industry has been concluded by Humphreys & Glasgow Ltd., the contracting engineers.

These include processes for the production of polyacrylonitrile, polyamide, polyester and viscose fibres, says the *Financial Times*.

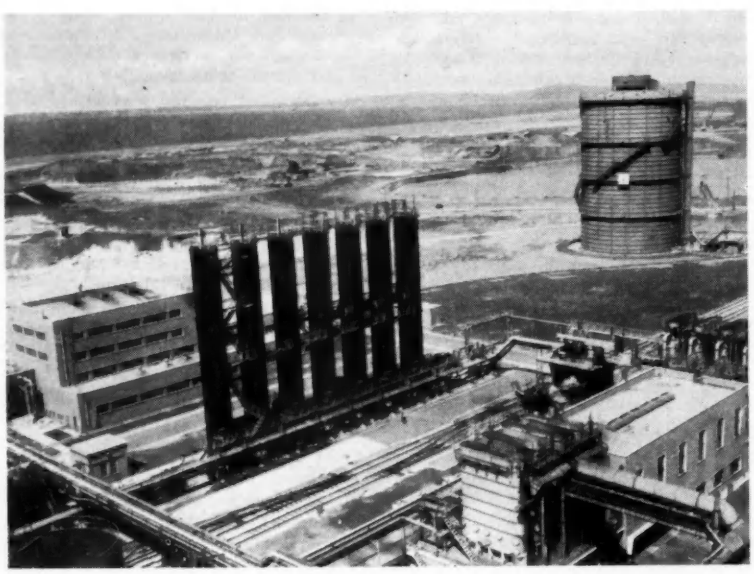
At the end of last year an agreement providing for the two-way purchase of chemical processes and information was reached between Humphreys & Glasgow and Limex, an East German State trading corporation.

## Wholly-owned subsidiary

IN a statement from Elliott-Automation Ltd. it is announced that La Thermostatique S.A., the French subsidiary of the Rheostatic Company (itself a member of the Elliott-Automation Group) has now become a wholly-owned subsidiary of the Group.

Recently it was announced that Elliotts had acquired a part of the minority shareholding in La Thermostatique by an exchange of shares in that Company for Elliott-Automation ordinary shares.

The Rheostatic Company has now negotiated the purchase of the whole of the outstanding balance of the shares in La Thermostatique for cash, so that that Company is now also a wholly-owned member of the Group.



*Mr. T. Mervyn Jones, Chairman, and Mr. E. M. Edwards, Deputy Chairman of the Wales Gas Board, were among those present at the recent opening of the Grange coking plant, at the Abbey plant of the Steel Company of Wales, Port Talbot, by Sir Frederick Scopes, Chairman of the British Coking Industry Association. This plant, supplied by Simon-Carves Ltd., Cheadle Heath, Stockport, consists of two blocks, each of 40 ovens, of the combined twin-flue underjet type, designed for a throughput of 1,550 tons of coal per day. Built on a completely new site, the Grange plant constitutes the No. 6 battery of the Margam works and brings the total number of ovens constructed there since expansion began to 310. Completely self-contained, the Grange plant has its own coal and coke plants, by-product plant and boosters for delivering gas to the steelworks system. By-products include ammonium sulphate, crude benzole and naphthalene. Shown left is a general view of the by-product plant.*

# 700 WILL ATTEND HARROGATE SALES CONFERENCE

THE seventh in the series of Sales and Service Conferences organised by the Gas Council will begin in Harrogate on the evening of November 6. The 700 delegates will then be the guests of the Mayor and Corporation of Harrogate and the Gas Council at a Civic Reception in the Royal Hall.

The next morning delegates will be welcomed by the Mayor of Harrogate, Councillor F. W. Allum, who is also Chief Accountant of the North Eastern Gas Board.

Following introductory remarks by the Chairman of the Gas Council, Sir Henry Jones, the meeting will be addressed by the Chairman of the Institute of Marketing and Sales Management and a Director of Horlicks Ltd., Mr. W. R. Bowden, who will give an assessment of the gas industry's marketing problems.

## *SHOWMANSHIP*

A Lecture Vivant entitled 'Showmanship' by Fanny and Johnnie Cradock ('Bon Viveur') will close the first session.

In the afternoon the second business session will be opened by the Deputy Chairman of the Gas Council, Mr. W. K. Hutchison, on 'Facts and Figures and the Plan for Gas,' and the Chairman of the Southern Gas Board, Mr. A. F. Hetherington, will speak on 'The Space Heating Age.'

On Wednesday, the Deputy Chairman of the Scottish Gas Board, Mr. H. R. Hart, takes the Chair with 'Gas Cooking our Basic Load,' and the Chairman of the North Eastern Gas Board, Dr. R. S. Edwards, will deal with 'The Water Heating Load.' In the afternoon, delegates will attend three concurrent sessions, each with a Board Chairman presiding.

## *'THE WAY AHEAD'*

The final session of the conference is on Thursday morning. Here points of view will be heard on 'The Way Ahead.' Sir Henry Jones will then introduce the Minister of Power, Mr. Richard Wood.

Admission to the Reception and all business sessions is by ticket only. The final programmes, tickets of admission and copies of contributions by the main speakers will be available later in the year.

## *MANUFACTURERS*

Appliance manufacturers wishing to attend who are not members of the Society of British Gas Industries, and anyone requesting further information should write to the Conference Organiser, Mr. R. J. Gregg, Publicity Manager, The Gas Council, 1, Grosvenor Place, London, S.W.1.

# Coal-washing plant contract

A CONTRACT has been received by Simon-Carves Ltd., of Cheadle Heath, Stockport, to design and erect a dense medium coal preparation plant at Bentley Colliery, in the North Eastern Division of the National Coal Board.

The plant will provide additional large coal cleaning facilities at Bentley. It will be capable of washing 250 tons per hour —the remainder will go either to the existing preparation plant or will be outloaded as a dry product.

Primary and secondary Drewboy dense medium separators, working in series, will comprise the new plant, together with all ancillary equipment. Site work is expected to start in approximately six months and it is estimated that the plant will be commissioned 18 months later.

## PERSONAL NOTES

MR. J. G. TILLEY, since vesting, general manager of the Huddersfield-Halifax Group, has been appointed General Manager, Leeds Group, North Eastern Gas Board. Mr. Tilley entered the gas industry in 1931, and in 1944 was appointed engineer and manager to Brighouse Corporation Gas Department. In 1948 he became general manager of the East Hull Gas Company. Mr. D. G. Wilson, has been appointed to succeed Mr. Tilley as General Manager of the Huddersfield-Halifax Group. In 1951 Mr. Wilson was appointed assistant area commercial officer to the South Western Gas Board, and went to Leeds in 1954 as coke officer to the North Eastern Gas Board.

MR. G. DAVIES, sales director of Humphreys & Glasgow Ltd., has been appointed Assistant Managing Director. MR. R. WITHERS and MR. D. LENNON have both joined the Board of Directors. Mr. Withers, is Chief Engineer; Mr. Lennon, is responsible for all overseas chemical plant. MR. D. YATES has been appointed an Associate Director and head of Humphreys & Glasgow's Construction Department. He was formerly a senior sales engineer in charge of overseas gas plant and all Australian contracts.

MR. N. J. MCKINNON has been appointed a Director of Trans-Canada Pipelines Ltd. Also elected to the Board are MR. B. MATTHEWS, C.B.E., MR. V. W. T. SCULLY, MR. R. W. CAMPBELL, and MR. E. L. KENNEDY.

# NEW ISSUE OF 'PACKAGING DIRECTORY'

THE 'Packaging Directory, 1961', published by The Tudor Press Ltd., is the 14th annual issue of what is claimed to be the most comprehensive guide to all aspects of packaging in Europe.

There is an increase of 81 pages of text compared with the 1960 edition, and the contents are in seven main divisions, which are sectionalised as required.

'The Buyers' Directory,' is divided into five sections: Containers and Closures, Materials, Packaging Machinery and Equipment, Mechanical Handling, and Services.

Under the division for 'Organisations, Associations and Consultants', 164 official organisations are listed, 13 international design organisations and associations comprise the next section, followed by 71 packaging consultants, who are members of the Society of Industrial Artists, and the 28 member, corresponding and associate-member organisations, of the European Packaging Federation complete the division.

A list of 'Foreign Firms with British Agents', 'Directory of Trade-Names', a small section on 'Forthcoming Exhibitions', and a list of over 2,750 names and addresses of all the firms, both manufacturers and suppliers, mentioned in the 'Buyers' Guide', completes the book. The price is 21s.

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